CONSUMER PREFERENCES FOR

FROZEN PASSION FRUIT JUICE

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Frank S. Scott, Jr.[1]

Basic to the development of a new food industry is adequate testing of consumer acceptance of the product. One of the more promising Hawaii products recently tested for consumer acceptance is frozen passion fruit juice. Consumer surveys by the Department of Agricultural Economics of the Hawaii Agricultural Experiment Station indicate that, although frozen passion fruit juice is generally acceptable to consumers, it appears likely that certain improvements in sugar and dilution ratios could bring about an increase in consumer demand.

PREFERENCES OF PASSION FRUIT JUICE IN RELATION TO OTHER JUICES

In HAES surveys, consumers in both Redlands, California, and Kailua, Oahu, Territory of Hawaii, have indicated a strong preference for frozen orange juice concentrate over frozen passion fruit juice. Redlands people also strongly preferred frozen lemonade base to frozen passion fruit juice, but in Kailua consumers preferred frozen passion fruit juice (fig. 1 and table 1).

Redlands consumers also preferred frozen grape juice to frozen passion fruit juice, but liked frozen limeade and frozen grapefruit juice about equally as well as frozen passion fruit juice. They preferred frozen passion fruit juice to frozen tangerine juice and frozen pineapple juice. Kailua consumers preferred frozen passion fruit juice to frozen limeade, frozen grapefruit juice, frozen tangerine juice, and frozen grape juice; but liked frozen pineapple juice equally as well as frozen passion fruit juice.

The somewhat greater preference for passion fruit juice in relation to other frozen juices in Kailua than in Redlands is understandable in light of the fact that consumers in Hawaii are more familiar with the product. Continued exposure to the product apparently has an important bearing on taste preferences. It would be logical to assume, therefore, that as mainland consumers become more accustomed to frozen passion fruit juice, preferences for it in relation to other juice products will increase.

SUGAR RATIO AND DILUTION PREFERENCES

The sugar-juice ratio of frozen passion fruit juice appears to be an important factor behind preferences for passion fruit juice in relation to other juices. A summarization of response to sugar ratio and dilution preferences in various mainland test areas is shown in table 2. The product was first introduced to Redlands con-

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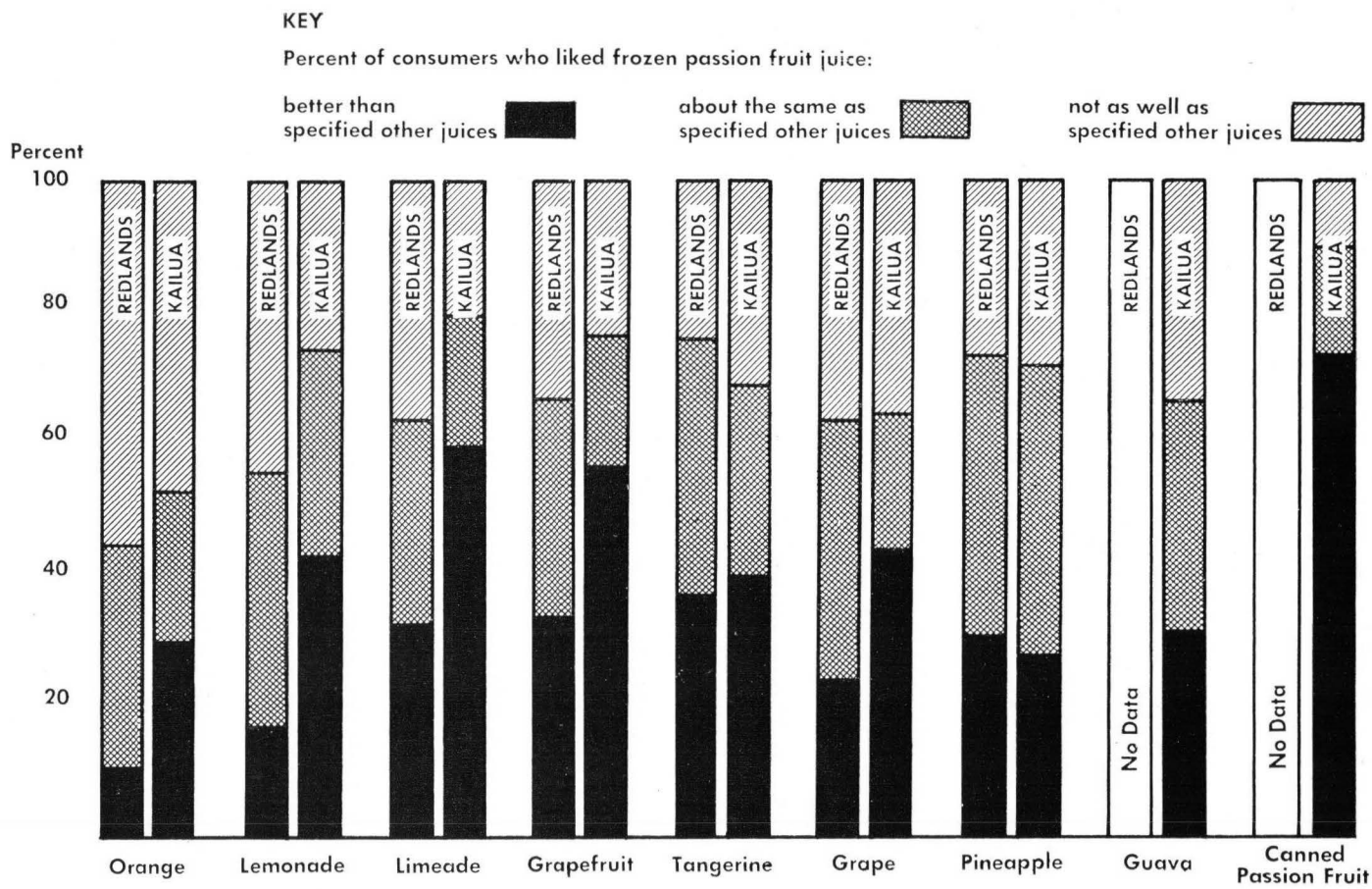

FIGURE 1. Consumer preferences for frozen passion fruit juice in relation to specified other frozen juices (6-ounce cans) and canned passion fruit juice, Redlands, California, and Kailua, Oahu, T. H.

TABLE 1. Percentage of Consumers Who Liked Frozen Passion Fruit Juice Better Than, About the Same As, or Not As Well As Other Specified Juices

	Frozen orange juice	Frozen lemonade	Frozen limeade juice	Frozen grapefruit juice	Frozen tangerine juice	Frozen grape juice	Frozen pineapple juice	Frozen guava juice	Canned passion fruit juice
	(*percent*)	(*percent*)	(*percent*)	(*percent*)	(*percent*)	(*percent*)	(*percent*)	(*percent*)	(*percent*)
Kailua-Lanikai									
Under $4,000									
Better than	36	40	50	52	25	41	37	19	56
About the same as	30	33	36	29	0	25	44	38	32
Not as well as	34	27	14	19	75	34	19	43	12
$4,000–$6,999									
Better than	29	41	56	57	33	44	32	36	76
About the same as	22	34	19	17	39	20	33	28	10
Not as well as	49	25	25	26	28	36	35	36	14
$7,000 and up									
Better than	28	50	68	58	52	46	30	41	85
About the same as	23	25	14	19	19	19	30	28	15
Not as well as	49	25	18	23	29	35	40	31	0
Kailua-Lanikai (all income groups)									
Better than	30	43	59	56	40	44	28	32	73
About the same as	23	31	20	20	29	20	44	34	16
Not as well as	47	26	21	24	31	36	28	34	11
Redlands (all income groups)									
Better than	11	17	32	33	37	24	31	—	—
About the same as	34	39	31	33	39	40	42	—	—
Not as well as	55	44	37	34	24	36	27	—	—

TABLE 2. Sugar Ratio and Dilution Preferences for Frozen Passion Fruit Juice in Specified Test Areas

Date	Test area	Sugar ratio	Dilution	Number of consumers tested	Percent who liked the juice	Percent who disliked the juice	Sweetness Factor			
							Just right	Too sweet	Too tart	Undecided
					(*percent*)	(*percent*)	(*percent*)	(*percent*)	(*percent*)	(*percent*)
Adults										
September, 1955	Redlands, Calif.	60:100	3 to 1	265	85	15	67	30	3	0
December, 1955	Redlands, Calif.	55:100	3 to 1	130	98	2	90	8	2	0
December, 1955	Redlands, Calif.	55:100	4 to 1	174	94	6	84	9	7	0
December, 1955	Redlands, Calif.	45:100	3 to 1	138	99	1	89	5	6	0
December, 1955	Redlands, Calif.	45:100	4 to 1	117	91	9	85	3	12	0
June, 1956	Kailua, Oahu, Hawaii	60:100	3 to 1	814	93	7	77	14	9	0
June, 1956	San Jose, Calif.	60:100	3½ to 1	1,277	94	6	88	12	0.2	0
July, 1956	San Mateo, Calif.	60:100	3½ to 1	317	90	10	90	8	2	0
August, 1956	Palo Alto, Calif.	60:100	3½ to 1	303	94	6	78	19	1	2
October, 1956	Redlands, Calif.	60:100	3 to 1	681	94	6	77	18	1	4
Children										
August, 1956	Palo Alto, Calif.	60:100	3½ to 1	162	94	6	—	—	—	—
October, 1956	Redlands, Calif.	60:100	3 to 1	217	99	1	96	3	1	0

sumers during May, 1955, with a ratio of 60 parts of sugar to 100 parts of juice and a dilution of three cans of water to one can of juice. In a personal interview survey made four months later, 85 percent of those who had purchased frozen passion fruit juice indicated that they liked the product; yet 30 percent indicated that it was too sweet. Only 3 percent were of the opinion that it was not sweet enough. It was assumed that the apparent excessive sweetness had an important deterring effect on repeat sales and accounted, at least in part, for the response on the part of the 15 percent of the people who did not like the juice at all.

In light of these findings and in order to arrive at a more acceptable combination of sugar and dilution ratios, further tests were conducted in Redlands in December, 1955. Acceptance tests for four different combinations of sugar and dilution ratios were conducted over a period of two days in two large markets with a half day devoted to each combination in each market. These combinations consisted of a 55:100 sugar-juice ratio at both a 3 to 1 dilution and a 4 to 1 dilution and a 45:100 sugar-juice ratio at both a 3 to 1 dilution and a 4 to 1 dilution. Each customer was permitted to taste and express a preference for only one combination, thus avoiding the confusion and consequent inaccuracy which exists when an attempt is made to evaluate a number of different combinations in succession. It was necessary to assume that similar populations were tested during each half day in each store. Samples were considered large enough to prevent significant bias from population differences. Of the December combinations, consumers had about equal preference for the 55:100 sugar-juice ratio with a 3 to 1 dilution and for the 45:100 sugar-juice ratio also with a 3 to 1 dilution. The greater dilution, regardless of the sugar-juice ratio, seemed to make the taste of the product less acceptable. Whereas 98 percent of the customers liked the 55:100 sugar-juice ratio and 99 percent liked the 45:100 sugar-juice ratio, both at a 3 to 1 dilution, there were important differences in response to the sweetness factor. Eight percent thought the 55:100 ratio was too sweet but only 2 percent considered it not sweet enough. And, although only 5 percent considered the 45:100 ratio too sweet, 6 percent considered it not sweet enough. Consideration should be given to the fact that sugar can be added by consumers who consider the juice too tart, but cannot be removed by those who think the juice too sweet.

The juice was further tested in San Jose, San Mateo, and Palo Alto, California, during the summer of 1956 and in Redlands during October, 1956. The percentage of consumers in the various test areas who considered the juice too sweet ranged from 8 percent in San Mateo to 19 percent in Palo Alto, with 2 percent or less considering it too tart in all test cities.

It is interesting to note that the percentage of Redlands people who liked the juice increased from 85 percent in September, 1955, to 94 percent in October, 1956. At the same time, the percentage who thought it was too sweet decreased from 30 percent to 18 percent. Repeated use of the juice by consumers in Redlands undoubtedly created a greater taste preference for the product. Also it is possible that there could have been some sampling bias, inasmuch as those people who had attained a liking for the juice may have been more willing to sample the juice during subsequent demonstrations.

The October tests in Redlands indicated that children were quite well satisfied with the 60:100 sugar-juice ratio.

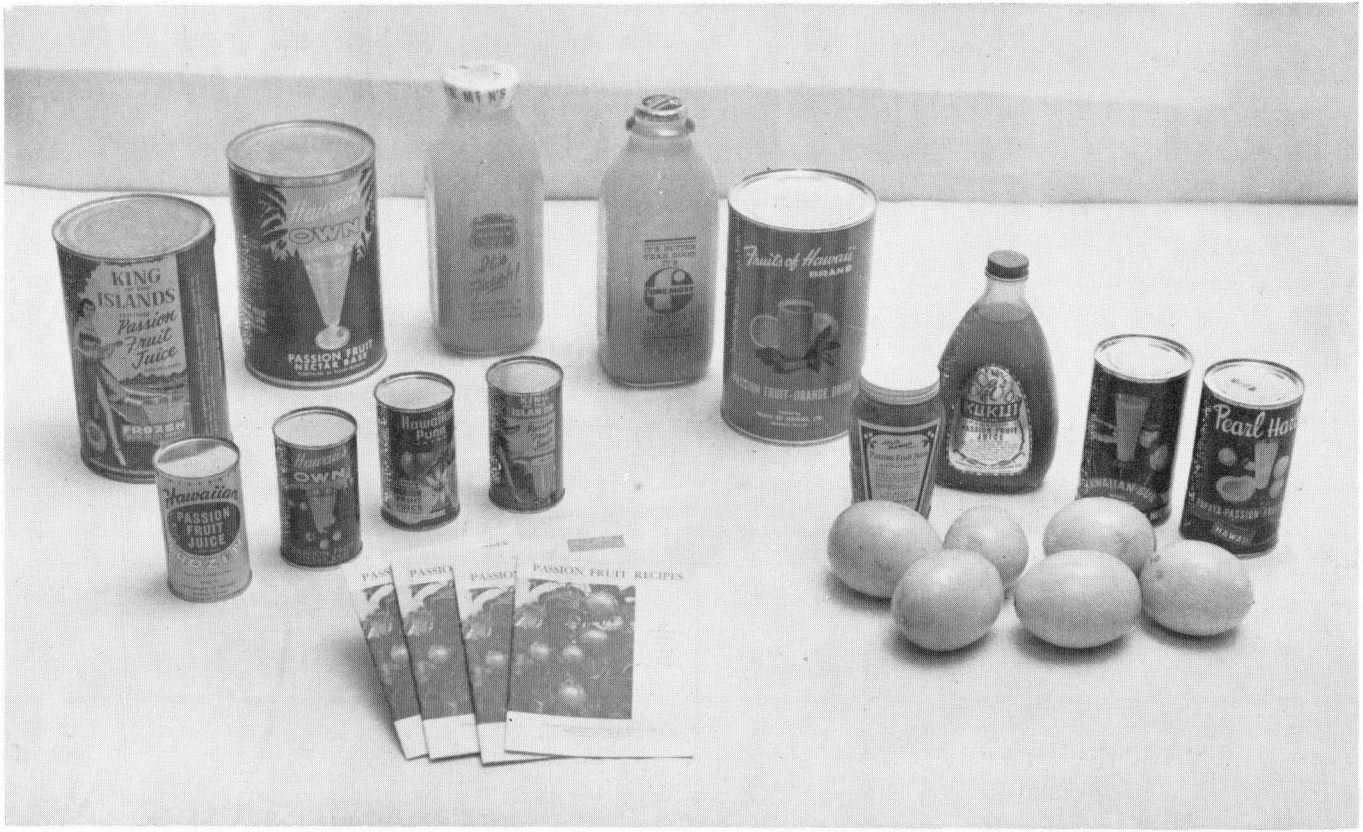

FIGURE 2. Processed forms of passion fruit juice. Passion fruit juice is available to consumers as frozen and heat processed concentrates, in cans as a pure juice or as a blend, and as a fresh juice in dairy bottles.

TABLE 3. Preferences of Children in Relation to Adults for Frozen Passion Fruit Juice, Kailua, Oahu*

Classification	Income group	Percentage of consumers who liked the juice:			
		Exceptionally well	Fairly well	Slightly	Not at all
Adults	Under $4,000	45	42	6	6
Children	Under $4,000	60	32	3	4
Adults	$4,000–$6,999	52	30	8	9
Children	$4,000–$6,999	53	31	9	7
Adults	$7,000 up	50	37	4	8
Children	$7,000 up	51	23	9	17
Adults	All income groups	51	34	7	8
Children	All income groups	54	30	8	9

*Based on household interviews, including 536 adults and 535 children. These households included all of the consumers who had bought passion fruit juice out of a 25 percent sample of Kailua homes (901 interviews and 814 usable schedules).

A comparison of tests by areas indicates that people in the somewhat cooler San Francisco Bay region prefer a somewhat sweeter product than in the hot and more arid regions of southern California.

The fact that very similar results were secured from different test stores in the same area would indicate that the sampling bias is not significant for tests of this type. Sufficient evidence is available to indicate that the sugar-juice ratio should not be more than 55:100 or less than 45:100 and the recommended dilution should be 3 to 1 if maximum sales are to be attained.

PREFERENCES OF CHILDREN IN RELATION TO ADULTS

In the Kailua survey (table 3), a slightly higher percentage of children than adults expressed a strong acceptance for passion fruit juice. Fifty-four percent of the children and 51 percent of the adults indicated that they liked the product exceptionally well. This difference does not seem to be great enough to justify the conclusion that children like the juice significantly better than do adults. It can be concluded that children seem to like the juice at least as well as and perhaps slightly better than do adults.

Acceptance by children in relation to adults varied considerably by income groups. In the income group of less than $4,000, children showed a decidedly stronger liking for frozen passion fruit juice than did adults. The difference was negligible in the middle income group but in the income group of over $7,000, although about the same percentages of adults and children like the juice exceptionally well, a lesser percentage of children liked it fairly well and slightly over twice as many children as adults did not like it at all.

In Palo Alto, children expressed about the same liking for frozen passion fruit juice as did adults. In the October, 1956, tests in Redlands, children expressed a stronger liking for the juice than did adults (table 2), especially with regard to the sweetness factors.

TABLE 4. Preferences for Frozen Passion Fruit Juice by Racial Groups, Kailua, Oahu

Racial group	Percent of adults who liked the juice:			
	Exceptionally well	Fairly well	Slightly	Not at all
	(percent)	*(percent)*	*(percent)*	*(percent)*
Hawaiian and part-Hawaiian	72	20	4	4
Caucasian	53	33	6	8
Japanese	31	44	17	8
All others*	58	33	6	3
Average of All Groups	51	34	8	7

*Samples of other groups were too small to allow separate breakdowns.

PREFERENCES BY RACIAL GROUPS

Preferences for frozen passion fruit juice as indicated in the Kailua survey varied considerably among racial groups. Strongest preferences were indicated by Hawaiians and part-Hawaiians (table 4). Almost three-fourths of this group liked the frozen passion fruit juice exceptionally well. Fifty-three percent of the Caucasians liked the juice exceptionally well and one-third liked it fairly well; whereas only 31 percent of the people of Japanese ancestry liked the juice exceptionally well and 44 percent liked it fairly well. The average of the preferences for all other groups was about the same as for the Caucasian. The average of all groups was close to that for Caucasians because of the predominance of Caucasians (72 percent) in the Kailua-Lanikai area.

USES OF PASSION FRUIT JUICE

The strong, appealing flavor of passion fruit permits its use for a number of purposes. In addition to its use as a pure juice, it is a standard constituent in a number of frozen and heat processed punches and provides an excellent flavor for pies, cakes, puddings, sauces, salads, and sherbets. The fresh juice and the diluted concentrate are considered excellent mixers for certain alcoholic beverages such as vodka, gin, and rum. A more detailed coverage of uses made of the product by consumers will be included in a forthcoming publication.

NUTRITIONAL VALUES

Because of extensive publicity relative to the vitamin values of certain food products, vitamin content is considered an important selling point in advertising frozen juices. Hence, a brief discussion of vitamin content seems necessary. Many food products naturally low in the more important vitamins are fortified with amounts often far exceeding the vitamin content of the high-vitamin products. Yet, a product advertised as being naturally high in vitamins may have an advertising advantage over the product which has been fortified.

Vitamin values of passion fruit juice are shown in comparison with those of certain competitive fruits and juices in table 5.

TABLE 5. Vitamin and Mineral Contents of Specified Fruit Juices*

	Vitamin A (as B. Carotene) (i.u.)	Vitamin C (Ascorbic Acid) (mg./ 100 gm.)	Vitamin B_1 Thiamine (mg./ 100 gm.)	Vitamin B_2 (Riboflavin) (mg./ 100 gm.)	Niacin (mg./ 100 gm.)	Ash (mg./ 100 gm.)	Calcium (mg./ 100 gm.)	Phosphorus (mg./ 100 gm.)	Iron (mg./ 100 gm.)
Apple Juice, fresh or canned	40	1	.02	.03	Trace	.3	6	10	.5
Grape Juice, bottled, commercial	—	Trace	.04	.05	(.2)	.4	10	10	.3
Grapefruit Juice, canned	Trace	33.2	.028	.017	.17	.4	8	13	.4
Grapefruit Juice Concentrate, frozen, reconstituted	7.5†	38.1	.048	.006	.26	.4	8	12	.1
Guava, common, raw	250	100–300	.07	.04	1.2	.7	30	29	.7
Guava Juice, common, frozen concentrate, reconstituted	—	22–25	—	—	—	—	—	—	—
Lemon Juice, canned, unsweetened	0	42	.04	Trace	.1	.3	14	11	.1
Lime Juice, fresh	0	27	(.04)	(Trace)	(.1)	.3	(14)	(11)	(.1)
Orange Juice, canned (sweetened and unsweetened)	100	35.0	.073	.020	.24	.5	10	19	.5
Orange Juice Concentrate, frozen, reconstituted	(83)†	47.2	.085	.013	.33	.4	9.2	16	.12
Passion Fruit Juice, yellow, fresh	570	10–20	Trace	.101	2.24	—	5	18	.3
Passion Fruit, diluted frozen concentrate†	143	2.5–5	.02	.03	.56	—	1	5	.1
Pineapple Juice, canned	80	8.5	.053	.018	.18	.2	15	9	.3
Pineapple Juice, frozen, reconstituted	—	13	.066	.016	.25	.4	10.8	8.3	.32
Prune Juice, canned	—	(1)	(.03)	(.08)	.4	.3	(25)	(40)	(1.8)
Tangerine Juice, canned, unsweetened	(420)	(26)	(.06)	(.03)	(.2)	.4	19	16	.2
Tomato Juice, canned	1,050	16	.05	.03	.8	1.0	(7)	(15)	(.4)

*Sources: (a) Bernice K. Watt and Annabel L. Merrill, *Composition of Foods*, USDA Handbook No. 8, June, 1950;
(b) Carey D. Miller, *et al.*, *Vitamin Values of Foods in Hawaii*, University of Hawaii Agricultural Experiment Station Technical Bulletin 30, May, 1956;
(c) Food Processing Laboratory, University of Hawaii.
(d) Quick Frozen Foods, June, 1956.

†Estimated by the writer on basis of dilution for reconstituting, except for the vitamin C value of diluted frozen passion fruit juice concentrate which was determined by the University of Hawaii Food Processing Laboratory.

One of the most valuable nutrients furnished by fruits is ascorbic acid or vitamin C. In passion fruit, like many other fruits, the quantity is variable but enough work has been done to show that the ascorbic acid varies between 10 and 20 mg./100 gms. for fresh pulp or undiluted juice. Because of its strong flavor and high acidity, it has been found desirable to dilute the juice 3:1 or 4:1. This means that the diluted product contains 2 to 5 mg. ascorbic acid/100 gms. which places it in the class of low ascorbic acid fruits. It should be pointed out, however, that even in the diluted state the ascorbic acid content of passion fruit juice exceeds that of some other popular juices such as grape, apple, and prune juices in the undiluted state.

Although the primary selling point for passion fruit would be expected to be its flavor, the vitamin composition in relation to other fruit juices should not be ignored. It may be feasible to fortify the juice with vitamin C to bring it up to or above the level of orange juice. This could be accomplished either through addition of ascorbic acid itself or through the addition of another fruit juice with high ascorbic acid content.

The possibility of blending a small amount of barbados cherry juice with passion fruit juice to increase the vitamin C content appears promising. The barbados cherry is upward of 40 times as high in vitamin C content as orange juice and only a small amount would be required to bring the vitamin C content of passion fruit to the desired level. Although barbados cherries are now being grown only on a small scale in Hawaii, the production outlook appears promising and the industry may be able to expand with that of passion fruit.

SUMMARY AND CONCLUSIONS

The effect of taste on sales of frozen passion fruit juice is influenced by two important factors, both of which can be changed. In the first place, the degree of sweetness and the actual quality of the juice have an important bearing on consumer purchases. Secondly, consumers are apt to prefer products with which they are familiar to new products for which they have not had an opportunity to acquire a taste. As consumers become more familiar with frozen passion fruit juice, preferences for this product in relation to competing juice products would be expected to increase.

In light of the relatively low vitamin C value of diluted frozen passion fruit juice, it is recommended that primary emphasis in promotion be placed on its exotic and appealing flavor.

The comparatively high acceptance of the juice on the part of Caucasians in Hawaii is an encouraging indication in contemplating the mainland market, where the population is predominantly Caucasian.

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